SEMICONDUCTOR COMPONENT FOR HIGH REVERSE VOLTAGES IN CONJUNCTION WITH A LOW ON RESISTANCE AND METHOD FOR FABRICATING A SEMICONDUCTOR COMPONENT

CROSS-REFERENCE TO RELATED APPLICATION

This application is a continuation of copending International Application No. PCT/EP00/08706, filed Sep. 6, 2000, which designated the United States.

BACKGROUND OF THE INVENTION

Field of the Invention

The invention relates to a semiconductor component having a semiconductor body of a first conductivity type. A semiconductor region of the first conductivity type is provided between two electrodes and can sustain a reverse voltage applied to the electrodes. Semiconductor regions of a second conductivity type, opposite to the first conductivity type, are provided in at least one plane extending essentially perpendicularly to a connecting line between the two electrodes. A cell array is disposed below one of the electrodes in the semiconductor body.

Unipolar power semiconductor components for high reverse voltages have a high on resistance due to the required low doping concentration of the semiconductor region that takes up the space charge zone. If the doping concentration is increased in this semiconductor region, then the blocking capability of the power semiconductor component decreases.

In order to solve this problem, additional, buried pn junctions can be produced in the bulk of the semiconductor region that takes up the reverse voltage. European Patent No. EP 0 344 514 B1 has already proposed a turn-off thyristor in which there is inserted into a base layer, which is not contact-connected by a gate electrode, at least one thin semiconductor layer which is not connected up to external a potentials and is doped oppositely relative to the base layer. Instead of such a non-contact-connected layer, at the present time preferably laterally uniformly distributed spherical semiconductor regions, which, if appropriate, can also form a network, are introduced into the semiconductor region that takes up the space charge zone, the semiconductor regions, having a conductivity type opposite to the conductivity type of the semiconductor region. The semiconductor regions are preferably floating. With a configuration of this type, the maximum electric field strength that occurs is limited depending on the basic doping in the semiconductor region and the distance between the electrically floating regions of the opposite conductivity type to the conductivity type of the semiconductor region.

International Publication No. WO 97/29518 describes a power semiconductor component according to the principle of charge carrier compensation. In that case, the drift zone of the semiconductor component has regions of different conductivity types, the total quantity of charge carriers of different conductivity types being approximately the same in these regions. When a reverse voltage is applied, the regions are mutually depleted, with the result that the semiconductor component exhibits an improved blocking capability. By virtue of the fact that the drift zone simultaneously has a higher doping concentration, the on resistance R_{on} is significantly reduced in the case of such a semiconductor component.

The fabrication of, for example, p-conducting semiconductor regions in an n-conducting semiconductor region can be effected through the use of a multistage epitaxy, in association with a phototechnology and a subsequent ion implantation.

If, in the semiconductor body of a semiconductor component, a plurality of such semiconductor regions of the second conductivity type which are provided essentially parallel to one another in different planes are cascaded in a semiconductor region of the first conductivity type, so that there are thus p-doped floating semiconductor regions, for example, in an n-conducting semiconductor region —which takes up the space charge zone —in different planes perpendicular to the connection direction between source electrode and drain electrode, then high reverse voltages in conjunction with a low on resistance R_{an} can be achieved with a semiconductor component of this type. In this way, it is thus possible to fabricate, for example, MOSFETs (Metal Oxide Semiconductor Field Effect Transistors) with a high reverse voltage together with a low on resistance R_{on}.

One disadvantage of electrically floating semiconductor regions of the second conductivity type in a semiconductor region —which takes up or accommodates the space charge zone —of the first conductivity type can be seen, however, in the fact that, especially in unipolar semiconductor components, the floating semiconductor regions delay switching operations: such slow switching operations are caused by the lack of coupling of the semiconductor regions of the second conductivity type to the source electrode or cathode, for example, via a unipolar conduction path.

SUMMARY OF THE INVENTION

It is accordingly an object of the invention to provide a semiconductor component for high reverse voltages in conjunction with a low on resistance which overcomes the above-mentioned disadvantages of the heretofore-known semiconductor components of this general type and in which switching operations proceed rapidly. It is a further object of the invention to provide a method for fabricating such a semiconductor component.

With the foregoing and other objects in view there is provided, in accordance with the invention, a semiconductor component, including:

two electrodes;

a semiconductor body of a first conductivity type, the semiconductor body including a semiconductor region of the first conductivity type provided between the two electrodes, the semiconductor region of the first conductivity type being configured to sustain a reverse voltage applied to the electrodes;

semiconductor regions of a second conductivity type disposed in at least one plane extending essentially perpendicularly to a connecting line extending between the two electrodes, the second conductivity type being opposite to the first conductivity type;

a cell array disposed under one of the electrodes in the semiconductor body; filiform semiconductor zones of the second conductivity type; and

at least some of the semiconductor regions of the second conductivity type being connected to the cell array via the filiform semiconductor zones of the second conductivity type.

In other words, a semiconductor component according to the invention includes a semiconductor body of the first conductivity type, in which a semiconductor region of the